



ROBOTICS

science for the 21st Century

will find new ways to exploit the capabilities of robots

Robots have come a long way since they were introduced to the world in their modern guise as “mechanical people” in a 1920 Czech play, but if the past few years are any guide, they may go further still.

The use of industrial robots, broadly defined as devices that perform work, has grown rapidly in factories, hospitals, research laboratories and the military. In the future, they may perform surgery, continue to replace humans for hazardous tasks, become household appliances, detect and defuse land mines, help the elderly and disabled, colonize other planets and conduct large-scale biological analyses for environmental management on Earth.

Robots first found a practical use in manufacturing applications such as welding, assembly and parts inspection. Later, they “found employment” in the military and in space. In recent years, they have been used in the medical industry, satellite systems, pharmaceutical development, entertainment and basic research.

At Los Alamos National Laboratory, robots and other automated devices have been used for years, primarily to transport, store and handle hazardous materials. More recently, they have helped characterize and clean contaminated equipment and soil, perform chemical analyses and laser diagnostics, and sequence basic genetic material.

Los Alamos robotics expertise is being integrated into major projects such as ARIES, a system to dismantle nuclear weapons safely; Telemed, a nationwide service providing rapid, reliable health care data to the medical community; and the National Ignition Facility, a laser fusion facility under construction at Lawrence Livermore National Laboratory.

In the future, the existing capabilities of robots at Los Alamos will be refined and expanded. Researchers also will study their potential uses in such areas as removing and cleaning contaminated filters, autonomous hazardous waste disposal, disposable sensor platforms and discovering new drugs.

Robots, most of which don’t even vaguely resemble humans, generally work faster and more precisely than people, they don’t get tired, and they can handle dangerous materials and work in dangerous situations. Their growing use is linked to the development of computers, sophisticated controls and other electronic equipment. Computers provide a way to control robots more precisely, allow adaptation to changing environments and, most importantly, reprogram their ability to handle more difficult, comprehensive tasks. Some researchers even define robots as the physical extensions of computers.

Other Los Alamos researchers are investigating the use of minimal autonomous robots that work without computers or human supervision, basing them on novel, fundamental principles of machine control. Such robots “learn” how to do their jobs in relatively unstructured environments, rather than being programmed for specific tasks.

Potential uses for these autonomous devices include detecting and destroying land mines, acting as tactical “scouts” in battlefield situations, cleaning areas of hazardous waste material, performing routine household tasks and investigating specific phenomena in space. In the future, autonomous robots will gain problem-solving abilities by being linked with computer-based neural networks, giving them animal-like skills to tackle real-world problems.

Robotics is taken seriously at Los Alamos, where the materials handling requirements are among the most stringent in the world. A robot that cleans kitchen floors is nice, but a robot that handles radioactive materials safely is essential. Los Alamos will continue to take advantage of improvements in mechanized sophistication, robustness and accuracy, while pursuing research to advance the field of robotics even further.

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